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IS 14439-1 (1997): Legal metrology - Gas volume meters,
Part 1: General requirements [PGD 26: Weights and Measures]



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“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

विधि माप विज्ञान — गैस आयतनमापी

भाग 1 सामान्य प्रावधान

Indian Standard

LEGAL METROLOGY — GAS VOLUME METERS

PART 1 GENERAL REQUIREMENTS

ICS 17.120.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Commercial Weights and Measures Sectional Committee had been approved by the Light Mechanical Engineering Division Council.

This standard prescribes the general requirements applicable to all types of gas volume meters including electronic gas meters. The additional requirements, specific to a particular type of gas volume meter, are being specified in separate standards covering particular type of gas volume meter.

The standard includes the terminology and definitions applicable to the gas volume meters. It also covers the provisions relating to location of verification and protection marks to detect/prevent any tempering and the provisions relating to pattern approval for metrological control.

The contents of this standard have been aligned with OIML Recommendation, OIML R 6 : 1989 'General provisions for gas volume meters' issued by the International Organization of Legal Metrology, France.

The standard on gas volume meters is currently being published in 3 parts as follows:

Part 1 General requirements,

Part 2 Diaphragm gas meters, and

Part 3 Rotary piston and turbine gas meters.

It is intended to bring out Part 4 of this standard in due course to cover the particular requirements for Electronic Gas Meters.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

LEGAL METROLOGY — GAS VOLUME METERS

PART 1 GENERAL REQUIREMENTS

1 SCOPE

This standard specifies the terminology, and general requirements applicable to gas volume meters.

2 REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
9000	Basic environmental testing procedures for electronic and electrical items:
(Part 2/Sec 3) : 1977	Cold test, Section 3 Cold test for non-heat dissipating items with gradual change of temperature
(Part 3/Sec 5) : 1977	Dry heat test, Section 5 Dry heat test for heat dissipating items with gradual change of temperature
(Part 5/Sec 2) : 1981	Damp heat (cyclic) test, Section 2 12+12 h cyclic
(Part 7/Sec 3) : 1979	Impact test, Section 3 Drop and topple
(Part 8) : 1981	Vibration (sinusoidal) test
9001	Guidance for environmental testing:
(Part 2) : 1977	Cold and dry heat tests
(Part 4) : 1979	Damp heat test

NOTE — Reference has also been made to certain IEC Publications where the Indian Standards do not exist on the subjects at present.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Working Range of a Gas Volume Meter

The range of the flow rates of gas limited by the maximum flow rate $Q_{\max}$ and the minimum flow rate $Q_{\min}$.

3.2 Cyclic Volume of a Gas Volume Meter (V)

The volume of gas corresponding to the working cycle of the gas volume meter, that is to all the movements of the moving components which, except for the indicating device and the intermediate transmissions, resume for the first time the position they occupied at the beginning of the cycle.

This volume is determined by multiplying the value of the volume corresponding to one complete revolution of the test element, or the value of the smallest scale interval, by the transmission ratio of the measuring device to the indicating device.

3.3 Test Element

A device to enable precise reading of the gas volume.

3.4 Metering Conditions and Base Conditions

3.4.1 Metering Conditions

Conditions of the gas, volume of which is to be measured, at the point of measurement (examples: temperature and pressure of the measured gas).

3.4.2 Base Conditions

Conditions to which the measured volume of gas is converted (examples: base temperature and base pressure).

NOTE — Metering and base conditions relate to the volume of gas to be measured or indicated only and should not be confused with 'rated operating conditions' and 'reference conditions', which refer to influence quantities.

3.5 Conversion Device

A device which converts the volume measured at the metering conditions to a volume at base conditions.

The type of conversion may

- a) temperature only,
- b) temperature and pressure, and
- c) temperature and pressure with correction for deviations from the ideal gas law.

3.6 Working Pressure

The difference between the absolute pressure of the gas to be measured at the inlet of the gas volume meter and at the atmospheric pressure.

3.7 Pressure Absorption

The difference between the pressures at the inlet and outlet of the gas volume meter while the gas is flowing.

NOTE — In some gas volume meters the pressure recovery is not complete at the outlet flange and it may be necessary to measure the pressure absorption at a point in the downstream pipe. This point shall be specified in the standard particular to that type of gas meter.

3.8 Output Drive Constant

The value of the volume corresponding to one complete revolution of the shaft of the output drive; this value is determined by multiplying the value of the volume corresponding to one complete revolution of the test element by the transmission ratio of the indicating device to this shaft.

3.9 Transitional Flowrate (Q_t)

The flowrate at which the maximum permissible error changes in value.

3.10 Electronic Gas Meter

A gas meter equipped with electronic devices.

NOTE — For the purpose of this standard auxiliary equipment, as far as it is subject to metrological control, is considered to be part of the gas meter, unless the auxiliary equipment is approved and verified separately.

3.11 Electronic Device

A device employing electronic components and performing a specific function. Electronic devices are usually manufactured as separate units and are capable of being independently tested.

NOTE — An electronic device, as defined above may be a complete gas meter or part of a gas meter.

3.12 Error (of Indication)

The indication of a gas meter minus the (conventional) true value of the measurand.

NOTE — Errors (E) are expressed in relative values by the ratio (expressed as a percentage) of the difference between the indicated value (V_i) and the conventional true value (V_c) of the volume of the test medium which has passed through the gas meter, to this latter value:

$$E (\%) = 100 \frac{V_i - V_c}{V_c}$$

3.13 Intrinsic Error

The error of a gas meter used under reference conditions.

3.14 Initial Intrinsic Error

The intrinsic error of a gas meter as determined prior to performance test and durability evaluations.

3.15 Fault

The difference between the error of indication and intrinsic error of a gas meter.

NOTES

- 1 Principally a fault is the result of an undesired change of data contained in or flowing through an electronic gas meter.
- 2 From the definition it follows that a "fault" is a quantity with a numerical value.

3.16 Significant Fault

3.16.1 A fault greater than 0.5 of the maximum permissible error on initial verification.

3.16.2 The following faults are considered not to be significant, even if they exceed the significant fault:

- a) faults arising from simultaneous and mutually independent causes in the gas meter itself or in its checking facilities.
- b) transitory faults being momentary variations in the indication, which cannot be interpreted, memorised or transmitted as a measurement result.

3.17 Durability Error

The difference between the intrinsic error after a period of use and the initial intrinsic error of a gas meter.

3.18 Significant Durability Error

3.18.1 The significant durability error is specified in the particular standard.

3.18.2 Durability errors are not relevant, even if they exceed the significant durability error, where the indications cannot be interpreted, memorized or transmitted as measurement results.

3.19 Influence Quantity

A quantity which is not the subject of the measurement but which influences the value of the measurand or the indication of the gas meter.

3.19.1 Influence Factor

An influence quantity having a value within the normal operating conditions of the gas meter.

3.19.2 Disturbance

An influence quantity not being an influence factor.

3.20 Normal Operating Conditions

Conditions of use, giving the range of values of influence quantities for which the metrological characteristics are intended to lie within the specified maximum permissible errors.

3.21 Reference Conditions

A set of specified values of influence factors fixed to ensure valid intercomparison of results of measurements.

3.22 Performance

The ability of the gas meter to accomplish the intended functions.

3.23 Durability

The ability of the gas meter to maintain its performance characteristics over a period of use.

3.24 Checking Facility

A facility which is incorporated in a gas meter and enables significant faults to be detected and acted upon.

NOTE — By 'acted upon' is meant any adequate response by the gas meter.

3.25 Durability Protection Feature

A feature which is incorporated in a gas meter and which enables durability errors in excess of the significant durability error to be detected and acted upon.

3.26 Test

A series of operations intended to verify the compliance of the equipment under test (EUT) with certain requirements.

3.26.1 Test Procedure

A detailed description of the test operations.

3.26.2 Test Programme

A description of a series of tests for a certain type of equipment.

3.26.3 Performance Test

A test to verify whether the EUT is able to accomplish its intended functions.

3.26.4 Durability Test

A test to verify whether the EUT is able to maintain its performance characteristics over a period of use.

4 GENERAL REQUIREMENTS FOR GAS VOLUME METERS**4.1 Field of Application**

These requirements apply to the following types of gas volume meters:

- a) Positive displacement gas meters (volumetric gas meters): diaphragm gas meters, rotary piston gas meters.
- b) Inferential gas meters : turbine gas meters.

NOTE — In this standard gas volume meters are referred to as 'gas meters'.

4.2 Construction**4.2.1 General**

Gas meters shall be designed and manufactured in such a way that they do not exceed maximum permissible errors under normal operating conditions of temperature as specified in 10.2(a) and over the ranges of temperature and pressure of the measured gas (metering conditions) as claimed by the manufacturer.

4.2.2 Materials

Gas meters shall be made of sound materials changing little with age and sufficiently resistant to corrosion and to the attacks of the gases for which the gas meters are intended to be used and their possible condensates.

4.2.3 Soundness of Cases

The cases of gas meters shall be gas-tight up to the maximum working pressure of the gas meters. If meters are to be installed in the open air they shall be impermeable to runoff water.

4.2.4 Protection Against External Interference

Gas meter shall be constructed in such a way that any mechanical interference capable of affecting the measuring accuracy results in permanently visible damage to the gas meter or to the verification mark or protection mark.

4.2.5 Direction of the Gas Flow

On gas meters where the indicating device registers positively for one direction only of the gas flow, this direction shall be indicated by an arrow. This arrow is not required if the direction of the gas flow is determined by the construction.

A protective device may also be provided which would prevent the functioning of the gas meter when the gas flow is in the direction opposite to that intended for measuring.

4.2.6 Metrological Properties

At a flowrate equal to ' $Q_{\max}$ ' a gas meter shall be able to function continuously for a time fixed by the

particular standard without the changes in its metrological properties exceeding the limits fixed by these requirements.

4.3 Additional Devices

4.3.1 Gas meters may be fitted with:

- prepayment devices,
- integral pulse generators, the outlets of which shall bear an indication of the value of one pulse in the form:
'1 imp. = ... m³ (or dm³)' or
'1 m³ = ... imp.',
- a built-in conversion device, and
- a built-in self-checking and possibly self-adjusting device.

These devices are regarded as forming an integral part of the gas meter; they shall have been installed in the gas meter at the time of pattern approval and initial verification.

4.3.2 Gas meters may be fitted with output drive shafts which should be taken to include drive shafts or other facilities for operating detachable additional devices. The torque which the gas meters are required to produce in order to drive the additional devices fitted shall not produce any changes in the gas meter indication greater than the specified values.

4.3.2.1 If there is only one drive shaft, it shall be characterized by an indication of its constant (C) in the form "1 Rev. = ... m³ (or dm³)", of the maximum permissible torque in the form " $M_{\max} = \dots N.m$ ", and of the direction of rotation.

4.3.2.2 If there are several drive shafts, each shaft shall be characterized by the letter ' M ' with subscript in the form: " $M_1, M_2, \dots M_n$ ", as well as by an indication of its constant in the form "1 rev. = ... m³ (or dm³)" and of the direction of rotation.

The following formula shall appear on the gas meter, preferably on the data plate:

$$k_1 M_1 + k_2 M_2 + \dots + k_n M_n \leq A N.m$$

where

' A ' is the numerical value of the maximum permissible torque applied to the drive shaft with the highest constant, where the torque is applied only to this shaft; this shaft shall be characterized by the symbol M_1 ,

k_i ($i = 1, 2, \dots n$) is a numerical value determined as follows:

$$k_i = \frac{C_1}{C_i}$$

M_i ($i = 1, 2, \dots n$) represents the torque applied to the drive shaft characterized by the symbol M_i ,

C_i ($i = 1, 2, \dots n$) represents the constant for the drive shaft characterized by the symbol M_i .

4.3.2.3 When not connected to an attachable additional device, the exposed ends of the drive shafts shall be suitably protected.

4.3.2.4 The connection between the measuring device and the intermediate gearing shall not be broken or altered, if a torque of three times the permissible torque as indicated in 4.3.2.1 and 4.3.2.2 is applied.

5 MARKINGS

5.1 Each gas meter shall bear, either on the face plate, or on a special data plate, the following markings:

- The pattern approval sign of the gas meter, if appropriate,
- The manufacturer's identification mark,
- The serial number of the gas meter and its year of manufacture,
- The designation of the gas meter; this designation is in the form of the capital letter ' G ', followed by a number fixed in the particular standard,
- The maximum flowrate: $Q_{\max} = \dots m^3/h$,
- The minimum flowrate: $Q_{\min} = \dots m^3/h$ (or dm^3/h)
- The maximum working pressure: $P_{\max} = kg/cm^2$ (or gm/cm^2),
- For volumetric gas meters, the nominal value of the cyclic volume: $V = \dots m^3$ (or dm^3),
- The range of the metering conditions in which the gas meter is required to work within the specified maximum permissible errors, expressed as:
 $t_m = \dots - \dots ^\circ C$,
 $P_m = \dots - \dots kg/cm^2$ (or gm/cm^2),
- If required, a commercial designation of the gas meter, a special serial number, the name of the gas distributor, the name of the repairer and the year of repair.

These markings shall be directly visible, easily legible and indelible under normal conditions of use of the gas meters.

5.2 The particular standard may prescribe other markings, such as the nature of the gas to be measured.

5.3 Without special authorization, the use of any marking other than those prescribed in the pattern approval document, unless required by other national regulations, is prohibited.

6 INDICATING DEVICES AND TEST ELEMENT

6.1 Indicating Device

6.1.1 General Requirements

6.1.1.1 Gas meters shall be equipped with an indicating device directly indicating the volume of gas measured.

The indicating device shall indicate the volume of the measured gas in cubic meters. The symbol 'm³' shall appear on the face plate.

The scale interval shall not exceed '1 m³' or the volume passed during one hour at $Q_{\min}$, whichever is the greater.

6.1.1.2 The indicating device may be:

- a) a mechanical indicating device as meant in 6.1.2,
- b) an electromechanical or electronic indicating device as meant in 6.1.3, and
- c) a combination of (a) and (b).

6.1.1.3 The indicating device shall correspond to one of the following possibilities:

- a) The gas meter has one indicating device displaying the volume at metering conditions. The symbol 'm³' shall appear on the face plate,
- b) The gas meter has two indicating devices, one displaying the volume at metering conditions, the other displaying the volume at base conditions. The symbol 'm³' shall appear on the face plate, accompanied by the specification of those base conditions, expressed as:
 $t_b = \dots^\circ\text{C}$ (or $^\circ\text{K}$),
 $p_b = \dots \text{kg/cm}^2$ (or gm/cm^2).

It shall be clear and unambiguous as to which of the indicating devices these markings relate.

NOTES

1 The values chosen for base conditions shall preferably be: 0°C, 15°C or 20°C and 0.010 2 kg/cm².

2 One display may be used for both indications.

- c) A diaphragm gas meter with a built-in temperature conversion device may have only one indicating device displaying the volume at base conditions. The symbol 'm³' shall appear on the face plate, accompanied by the specification of the base temperature, expressed as:

$$t_b = \dots^\circ\text{C}$$

NOTE — The values chosen for base temperature shall preferably be: 0°C, 15°C or 20°C.

6.1.1.4 The indicating device shall be so designed that the reading is by simple juxtaposition.

6.1.2 Mechanical Indicating Device

6.1.2.1 A mechanical indicating device shall consist of drums; the last element (that is, the one with the smallest scale interval) may however be an exception to this rule.

NOTE — It appears that in certain designs, the mandatory use of drums in mechanical indicating devices causes, at present, great inconvenience. In consequence, these designs are, provisionally, in need of requirements for indicating devices with pointers. It is recommended that for this purpose they apply to the requirements in Annex A.

6.1.2.2 Where the indicating device includes drums showing decimal submultiples of the cubic metre, these drums shall be separated by a clear decimal sign from those showing cubic metres. The decades after the decimal sign shall be clearly distinguished from those in front of the decimal sign.

6.1.2.3 Where the last drum shows a decimal multiple of the cubic metre, the face plate shall bear:

- a) either one (or two, or three, etc) fixed zero(s) after the last drum,
- b) or the marking: 'X 10' (or 'X 100', or 'X 1000', etc), so that the reading is always in cubic metres.

6.1.2.4 A mechanical indicating device shall have at least a sufficient number of drums to ensure that the volume passed during 2 000 hours at maximum flowrate does not return all the drums to their initial positions.

6.1.2.5 The diameter of the drums shall be at least 16 mm.

6.1.2.6 The advance by one unit of a figure of any order shall take place completely while the figure of an order immediately below passes through the last tenth of its course.

6.1.2.7 A mechanical indicating device shall be easily removable if such removal is necessary for verification.

6.1.3 Electromechanical or Electronic Indicating Device

6.1.3.1 Electromechanical or electronic indicating devices shall be nonresettable and shall be nonvolatile (that is, it must be able to show the last correct indication after the device has recovered from an intervening power failure).

6.1.3.2 The provisions of 6.1.2.2, 6.1.2.3 and 6.1.2.4 are also applicable to electromechanical and electronic indicating devices.

6.2 Test Element

6.2.1 General Requirements

6.2.1.1 Gas meters shall be designed in such a way that they may be verified with sufficient accuracy in a reasonably short time. For this purpose they shall be constructed either with an integral test element or with arrangements permitting the connection of a portable test unit.

6.2.1.2 If a gas meter has two indicating devices as permitted in 6.1.1.3 (b), each indicating device shall have a test element, in order to verify the performance of the conversion device with sufficient accuracy in a reasonably short time.

6.2.2 Test Element of a Mechanical Indicating Device

6.2.2.1 The integral test element may consist of the last element of the mechanical indicating device in one of the two following forms:

- a) A continuously moving drum bearing a scale,
- b) A pointer moving over a fixed dial with a scale, or a disk with a scale moving past a fixed reference mark. The diameter of the graduated scale shall at least be 16 mm.

6.2.2.2 On the numbered scale of a test element referred to in 6.2.2.1(b) the value of one complete revolution of the pointer shall be indicated in the form: '1 rev. = ... m³ (or dm³)'. The beginning of the scale shall be indicated by the figure zero.

6.2.2.3 The scale spacing shall not be less than '1 mm' and shall be constant throughout the whole scale.

6.2.2.4 The scale interval must be in the form '1 × 10ⁿ', '2 × 10ⁿ', or '5 × 10ⁿ m³' (n being a positive or negative whole number or zero).

6.2.2.5 The scale marks shall be fine and uniformly drawn.

In the case where scale interval is in the form '1 × 10ⁿ', or '2 × 10ⁿ m³', all the lines representing multiples of 5, and where the scale interval is in the form '5 × 10ⁿ m³', all the lines representing multiples of 2, shall be distinguished by being longer than the other lines. The scale marks shall be sufficiently thin to permit accurate and easy reading.

6.2.2.6 The test element may be provided with a scale mark which stands out in contrast to the scale and is of sufficient size to allow automatic photoelectric scanning. This scale mark shall not obscure the graduation and its presence shall not be detrimental to the accuracy of reading.

6.2.3 Pulse Generator Used as Test Element

6.2.3.1 A pulse generator may be used as a test element if it complies with the requirements of 6.2.3.2 to 6.2.3.6.

6.2.3.2 The value of one pulse, expressed in units of volume, shall be marked on the gas meter. This value shall comprise at least 6 significant figures, unless it is equal to an integer multiple or decimal fraction of the unit of volume indicated on the face plate of the indicating device.

6.2.3.3 The pulse value shall be calculated from the transmission ratio between the indication of the gas meter and the location where the pulses are generated.

The manufacturer shall, at verification, submit documentation by which the calculation of the pulse value can be checked.

6.2.3.4 The gas meter shall be constructed in such a way that, prior to initial verification, the calculated pulse value as specified can be checked experimentally with an uncertainty not greater than 0.05 percent.

6.2.3.5 If a removable pulse generator is used, it shall be possible to attach and remove this pulse generator easily.

If the gas meter needs to supply a torque to drive the removable pulse generator, this torque shall have a negligible influence on the performance of the gas meter. The removable pulse generator is considered to comply with this requirement if the influence is less than 0.1 percent at a flowrate equal to 0.1 Q_{max}.

6.2.3.6 Measures shall be taken to prevent the cyclic volume of the gas meter having an influence on the accuracy of the verification.

NOTE — This can be accomplished by counting a number of pulses that match an integer multiple of the cyclic volume, or by measuring a volume large enough to make the influence negligible.

7 MAXIMUM PERMISSIBLE ERRORS

7.1 The values of the maximum permissible errors are fixed in the particular standard. They are valid for the authorized direction of flow.

7.2 If the gas meter has two indicating devices, one reading the volume at metering conditions and the other the volume at base conditions, the values of the maximum permissible errors apply to the indicating device for the volume at metering conditions. The difference in the errors of indication determined from both indicating devices

shall not be more than the value specified in the following table:

Type of Conversion	Maximum Difference in Error (%)			
	On initial verification		In service	
	conditions		conditions	
	Ref	Non Ref	Ref	Non Ref
a) Temperature	0.5	1.0	0.7	1.5
b) Temperature and pressure	0.8	1.3	1.2	1.9
c) Temperature and pressure and ideal gas law deviations	1.0	1.5	1.5	2.2

The reference conditions as specified in 10.2 (a) are applicable. Non reference conditions are normal operating conditions as specified in 10.2 (a), other than reference conditions.

NOTES

1 It may be possible to use one display for both indications.

2 In-service values are recommended values.

7.3 For a gas meter as meant in 6.1.1.3(c) the conventional true value at the metering temperature shall be converted to the volume at base temperature. The particular standard may specify larger maximum permissible errors for the type of gas meter covered in that particular standard.

8 PRESSURE ABSORPTION

The maximum permissible values of pressure absorption may be fixed if appropriate, by the particular standard.

9 LOCATION OF VERIFICATION AND PROTECTION MARKS

9.1 General Provision

The location of the marks shall be chosen in such a way that the dismantling of the part sealed by one of these marks results in permanently visible damage to this mark.

9.2 Data Plate

Gas meters shall have a special location for applying the verification mark; removal of the data plate shall result in permanently visible damage to this mark.

9.3 Other Locations

Locations for verification or protection marks shall be provided on every gas meter:

- on all plates which bear information prescribed by this standard and/or by the particular standard,
- on all parts of the case which cannot be otherwise protected against interference

likely to affect the accuracy of the measurement.

- on the connection with the detachable additional devices referred to in 4.3.2.3.

10 PROVISIONS FOR ELECTRONIC GAS VOLUME METERS

It specifies the general, technical and metrological requirements for electronic gas meters, as they are defined in this standard, in view of the application of electronics.

10.1 Application Conditions for Electronic Gas Meters

10.1.1 *Classification for Environmental Conditions*
Gas meters are classified according to their intended use under various environmental conditions, into the following classes.

- Class B : This class applies, to enclosed locations, having only low levels of vibration and shock.
- Class C : This class applies to locations having a general open air climate and only low levels of vibration and shock.
- Class F : This class applies to locations having a general open air climate and medium levels of vibration and shock.

10.2 Influence Factors

- Temperature:
 - Normal operating conditions: Class B: between -10°C to $+40^{\circ}\text{C}$
 - Classes C and F: between -25°C to $+55^{\circ}\text{C}$
 - Reference condition: a value between 15°C to 25°C
- Relative humidity:
 - Normal operating conditions: ≤ 93 percent
 - Reference conditions: a value between 40 to 60 percent
- Variations in the mains power supply:
 - Normal operating conditions: the specified severity level (see Annex B)
 - Reference conditions: no variation
- External magnetic fields:
 - Normal operating conditions: test conditions specified in 12.5.3
 - Reference condition: the absence of external magnetic fields.

10.3 Disturbances

- Vibration (Class F only),

- b) Shock (Class F only),
- c) Power interruptions,
- d) Bursts,
- e) Electrostatic discharge, and
- f) Electromagnetic interference.

Operating conditions: the specified severity levels (see Annex B)

Reference conditions: the absence of the disturbance.

10.4 Battery Power Supply

Gas meters which operate from a battery or other power source which must periodically be replaced shall indicate the need for replacement, at least 90 days before power failure. Replacement of the power source shall not adversely affect the programming, metering information, or subsequent operation of the gas meter.

11 REQUIREMENTS FOR ELECTRONIC GAS METERS

Electronic gas meters shall comply with the following requirements, notwithstanding all other technical and metrological requirements.

11.1 General Requirements

11.1.1 Electronic gas meters shall be designed and manufactured in such a way that they do not exceed maximum permissible errors under normal operating conditions.

11.1.2 Electronic gas meters shall be designed and manufactured in such a way that, when they are exposed to disturbances, significant faults do not occur.

NOTES

1A fault equal to or smaller than the value as meant in 3.16.1 is allowed irrespectively of the value of the error of indication.

2This requirement does not prohibit the use of checking facilities.

11.1.3 The provisions of 11.1.1 and 11.1.2 shall be met durably. Electronic gas meters shall be designed and manufactured in such a way that:

either:

- a) the significant durability error is not exceeded, or
- b) a durability error exceeding the significant durability error is detected and acted upon by means of a durability protection feature.

11.1.4 The pattern of a gas meter is presumed to comply with the requirements stated in 11.1.1, 11.1.2 and 11.1.3 if it passes the examination and tests specified in 12.5 and in the particular standard.

11.1.5 The choice, whether 11.1.3 (a) or 11.1.3 (b) is applied, is left to the manufacturer.

11.2 Requirements for electronic gas meters fitted with durability protection features

11.2.1 It shall be possible to verify the presence and correct functioning of these features.

NOTE — This verification may be accomplished by means of a test button or by any other means.

11.2.2 The requirement of 11.2.1 does not apply to gas meters or parts of gas meters for which the manufacturer claims that they comply with the requirements of 11.1.3 (a) and which are nevertheless equipped with durability protection features.

12 METROLOGICAL CONTROL

As the gas meters are subject to state metrological controls, it is recommended that they include all or some of the following controls.

12.1 Pattern Approval

12.1.1 Each pattern of a gas meter from each manufacturer is subject to the pattern approval procedure.

12.1.2 Without special authorization, no modification may be made to an approved pattern.

12.1.3 Applications for pattern approval for gas meters shall be accompanied by the following documents:

- a description of the meter giving the technical characteristics and the principle of its operation,
- a perspective drawing or photograph of the meter,
- a nomenclature of parts with a description of constituent materials of such parts,
- an assembly drawing with identification of the component parts listed in the nomenclature,
- a dimensioned drawing,
- a drawing showing the location of verification marks and seals,
- a drawing of the indicating device with adjustment mechanisms,
- a dimensioned drawing of metrologically important components,
- a drawing of the data plate or face plate and of the arrangements for inscriptions,
- where appropriate; a drawing of the additional devices,
- where appropriate; a table setting out the characteristics of the drive shafts,
- where appropriate; a list of electronic components with their essential characteristics,
- where appropriate; a description of the electronic devices; with drawings, diagrams

and general software explaining their construction and operation,

- where appropriate; the application for pattern approval shall be accompanied by any document or other evidence which supports the assumption that the design and construction of the electronic gas meter comply with the requirements,

NOTE — Safety requirements are to be respected.

- a list of the documents submitted, and
- a declaration specifying that the meters manufactured in conformity with the pattern meet the requirements for safety, particularly those concerning the maximum working pressure as indicated on the data plates.

12.1.4 The following particulars shall appear on the pattern approval certificate:

- the name and address of the person to whom the pattern approval certificate is issued,
- the type of the gas meter and/or commercial designation,
- the principal technical and metrological characteristics, such as the minimum flow, maximum working pressure, nominal internal diameter of the connecting pieces and, in the case of volumetric gas meters : the nominal value of the cyclic volume,
- the pattern approval sign,
- the period of validity of the pattern approval,
- for meters equipped with drive shafts:
 - a) the characteristics of the shaft as set out in 4.3.2.1 (where there is only one drive shaft),
 - b) the characteristics of each shaft and the formula given in 4.3.2.2 (where there are two or more drive shafts),
- the environmental classification,
- information on the location of the pattern approval sign, initial verification marks and seals (where appropriate, in the form of photographs or drawings),
- a list of the documents accompanying the pattern approval certificate, and any special comments.

12.1.5 Tests for Electronic Gas Meters

Electronic gas meters shall be subjected to the following examinations and tests:

- a) examination to verify whether the gas meter complies with the requirements of 11.1.
- b) performance tests to verify compliance with the requirements of 11.1.1, regarding influence factors, and 11.1.2, regarding disturbances. During these tests the EUT shall be in an operational state (that is, the power shall be switched on).

- c) durability evaluation (that is, tests and/or other measures) to verify compliance with the requirements of 11.1.3.
- d) examination and test to verify where applicable the compliance of the electronic gas meter with the requirements of 11.1.3 and 11.1.4.

All gas meters, whether or not equipped with checking facilities and whether or not equipped with durability protection features, are subject to the same test-programme.

12.1.5.1 Performance tests (carried out prior to durability tests)

During these tests the gas meter shall comply with:

- the requirements of 11.1.1, the maximum permissible error and being the maximum permissible error on initial verification,
- the requirements of 11.1.2.

12.1.5.2 Durability programme

During performance tests carried out after each durability test the gas meter shall comply with requirements of 11.1.

12.1.5.3 Test performance

The following tests shall be performed:

Influence factors:

- a) Static temperatures, dry heat:
See Annex B, B-1,
Severity level : Class B: severity level 1 Classes C and F : severity level 2
- b) Static temperatures, cold:
See Annex B, B-2,
Severity level : Class B : severity level 1
Classes C and F : severity level 2
- c) Damp heat, cyclic :
See Annex B, B-3
Severity level : Class B : severity level 1
Classes C and F : severity level 2
- d) Mains power supply variations:
See Annex B, B-4, severity level 1
- e) External magnetic fields:
Electronic gas meters shall be subject to tests in any orientation within a 50 Hz (60 Hz) alternating magnetic field equivalent to that produced by a circular coil, one meter in diameter having 400 Ampere turns.

Disturbances:

- a) Vibration (Class F only):
See Annex B, B-5 severity level 1
- b) Shock (Class F only):
See Annex B, B-6, severity level 1
- c) Short time power reduction:
See Annex B, B-7, severity level 1

- d) Electrical bursts:
See Annex B, B-8, severity level 1
- e) Electrostatic discharge:
See Annex B, B-9, severity level 1
- f) Electromagnetic susceptibility:
See Annex B, B-10, severity level 1

12.1.5.4 Test procedures

The test procedures are specified in Annex B.

12.1.5.5 Equipment under test (EUT)

As a rule, tests will be carried out on the complete gas meter. If the size or configuration of the gas meter does not lend itself to testing of the gas meter as a whole unit, or if only a separate device of the gas meter is concerned, the tests shall be carried out on the electronic devices, provided that, in case of tests with the devices in operation, these devices are

included in a simulated measurement set-up, sufficiently representative for its normal operation.

NOTE — It is not intended that the gas meters or devices be dismantled for the tests.

13 INITIAL VERIFICATION

New gas meters are subject to the procedure for initial verification. They shall comply with the relevant requirements. These requirements apply equally to subsequent verifications of repaired or readjusted gas meters.

14 SUBSEQUENT VERIFICATIONS

Recommended requirements for subsequent verifications may be given in the particular standards.

ANNEX A*(Clause 6.1.2.1)***INDICATING DEVICES WITH POINTERS**

A-1 The face of an indicating device with pointers shall have circular scales intended for reading the volume of measured gas, each graduated into 10 divisions of the same length. The scale marks shall be numbered successively from 0 to 9, the "0" scale mark being at the top of the scale. The diameter of the circular scales shall be at least equal to 16 mm.

The face shall have enough numbered circular scales to indicate the volume delivered during 2 000 hours working at maximum flowrate.

The symbol 'm³' shall appear on the dial.

A-2 The intermediate transmissions of the indicating device with a pointer shall be so arranged that the direction of rotation of the pointers of circular scales alternates when one considers the next circular scale of which the value, in volume, shall be ten times greater or ten times smaller.

A-3 The pointer moving at the highest speed shall be on the right hand side of the indicating device when viewed by an observer standing in front of the meter.

The direction of rotation of this pointer shall be clockwise. The value of a complete revolution of

this pointer shall correspond to 10 m³, or 100 m³, or, etc.

A-4 Each numbered circular scale shall indicate clearly and nonambiguously the value, in units of volume, corresponding to one complete revolution of its pointer. The direction of rotation of the pointer shall be indicated by means of an arrow.

A-5 Circular scales not intended to indicate the measured volume of gas (for example, scales intended for the verification of the meter or the control of its metrological qualities) are authorized. However, these scales shall be off the geometric line on which the circular scales used for indicating the volumes of measured gas are aligned.

A circular scale not intended to indicate the volume of gas measured for use shall carry, within the circle, a clear indication of the value of the volume corresponding to one complete revolution of the pointer. The scale shall have 10 divisions of the same length, the scale marks not being numbered. An arrow shall indicate the direction of rotation of the pointer.

ANNEX B*(Clauses 10.2, 10.3, 12.1.5.3 and 12.1.5.4)***TESTS FOR ELECTRONIC GAS METERS****B-1 DRY HEAT TEST (NON-CONDENSING)**

B-1.1 The test consists of exposure to the specified high temperature under "free air" condition for the time specified (The time specified is the time after the EUT has reached temperature stability).

B-1.2 The test shall be conducted in accordance with IS 9001 (Part 2) and IS 9000 (Part 3/Sec 5).

B-1.3 The change of temperature shall not exceed 1°C/min during heating up and cooling down.

B-1.4 The absolute humidity of the test atmosphere shall not exceed 20 g/m³.

B-1.5 Prior to the test the EUT shall be calibrated under reference conditions. During the test the error of indication shall be determined several times.

B-1.6 Test Severity

The following severities shall apply:

Severity	1	2
Temperature(°C)	40	55
Duration (hours)	2	2

B-2 COLD TEST

B-2.1 The test consists of exposure to the specified low temperature under "free air" condition for the time specified (The time specified is the time after the EUT has reached temperature stability).

B-2.2 The test shall be conducted in accordance with IS 9001 (Part 2) and IS 9000 (Part 2/Sec 3).

B-2.3 The change of temperature shall not exceed 1°C/min during heating up and cooling down.

B-2.4 Prior to the test the EUT shall be calibrated under reference conditions. During the test the

error of indication shall be determined several times.

B-2.5 Test Severity

The following severities shall apply:

Severity	1	2
Temperature(°C)	- 10	- 25
Duration (hours)	2	2

B-3 DAMP HEAT, CYCLIC

B-3.1 The test consists of exposure to cyclic temperature variation between 25°C and the appropriate upper temperature, maintaining the relative humidity above 95 percent during the temperature change and low temperature phases, and at 93±3 percent at the upper temperature phases.

B-3.2 The test shall be conducted in accordance with IS 9001 (Part 4) and IS 9000 (Part 5/Sec 2).

B-3.3 Condensation should occur on the EUT during the temperature rise.

B-3.4 Prior to the test the EUT shall be calibrated under reference conditions. During the test the error of indication shall be determined several times.

B-3.5 Test Severity

The following severities shall apply:

Severity	1	2
Upper temperature (°C)	40	55
Duration (cycles)	2	2

B-4 VARIATIONS IN MAINS POWER SUPPLY

B-4.1 The test for variation in ac mains power supply (single phase) consists of exposure, at normal atmospheric conditions for testing, to the specified power supply condition for a period long enough to achieve temperature stability and to perform the required measurements.

B-4.2 Test Severity

The following severity shall apply:

Severity	1
Mains voltage(V) upper limit	V(nom) + 10%
lower limit	V(nom) - 15%
Mains frequency upper limit	f(nom) + 2%
(Hz) lower limit	f(nom) - 2%

NOTE — For a three-phase power supply the voltage variation shall apply to each phase successively.

B-5(a) VIBRATION (RANDOM)

B-5(a).1 The test consists of exposure to vibration for a time long enough to test the various functions

of the EUT during the exposure. The EUT shall be tested in three mutually perpendicular axes in turn, mounted on a rigid fixture by its normal mounting means.

The EUT shall normally be mounted so that the gravitational force acts in the same direction as it would when the instrument is in use. Where the effect of gravitational force is not important the EUT may be mounted in any attitude.

B-5(a).2 Test Severity

The following severity shall apply:

Severity	1
Total frequency range (Hz)	10-150
Total RMS level (m.s ⁻²)	1.6
ASD level, 10-20 Hz (m ² .s ⁻³)	0.048
ASD level, 20-150 Hz (dB/octave)	-3
Number of axes	3
Duration per axis	Minimum 2 minutes in each functional mode

NOTE — For test details reference may be made to IEC publication 68-2-36, first edition, 1973, Basic environmental testing procedures, Part 2: Test, test Fdb: Random vibration reproducibility wide band — medium, as there is no Indian Standard available on the subject at present.

B.5(b) VIBRATION (SINUSOIDAL)

(As an alternative to the random vibration test)

B-(b).1 The test shall be conducted in accordance with IS 9000 (Part 8).

B-5(b).2 Test Procedure

The EUT shall be tested by sweeping the frequency in the specified frequency range, at 1 octave/minute, at the specified acceleration level with a specified number of sweep cycles per axis. The EUT shall be tested in its three, mutually perpendicular, main axes, mounted on a rigid fixture by its normal means. It shall normally be mounted so that the gravitational force acts in the same direction as it would when the instrument is in use. Where the effect of gravitational force is not important, the EUT may be mounted in any attitude.

B-5(b).3 TEST SEVERITY

The following severity shall apply:

Severity	1
Frequency range (Hz)	10-150
Max acceleration level (m/s ²)	2
Number of sweep cycles per axis	20

B-6 MECHANICAL SHOCK

B-6.1 Test Procedure

The test shall be conducted in accordance with IS 9000 (Part 7/Sec 3). The EUT, standing in its

normal position of use on a rigid surface, shall be tilted about one bottom edge and then allowed to fall freely onto the test surface. All covers shall be properly fitted.

B-6.2 Test Severity

The following severity shall apply:

Severity	1
Height of fall (mm)	25
Number of falls (for each bottom edge)	2

NOTE — Height of fall means distance between the elevated edge and the test surface. However, the angle made by the bottom and the test surface shall not exceed 30°.

B-7 SHORT-TIME POWER REDUCTION

B-7.1 The test is carried out to determine the effect of short-time interruptions and reductions in mains voltage.

B-7.2 Test Procedure

A test generator suitable to reduce the amplitude of one or more half cycles (at zero crossings) of the ac mains voltage is used. The test generator shall be adjusted before connecting the EUT. The mains voltage interruptions and reductions shall be repeated ten times with an interval of at least 10 seconds.

B-7.3 Test Severity

The following severities shall apply:

Severity	1a	1b
Reduction	100 %	50 %
Number of half cycles	5	10

B-8 ELECTRICAL BURSTS

B-8.1 Test Procedure

The test consists of exposure to bursts of double exponential waveform transient voltages. Each spike shall have a rise time of 5 ns and a half-amplitude duration of 50 ns.

The burst length shall be 15 ms, the burst period (repetition time interval) shall be 300 ms. The burst generator shall have an output impedance of 50 ohms and shall be adjusted before connecting the EUT. Bursts shall be coupled to the EUT both in common mode and differential mode interference. At least 10 positive and 10 negative randomly phased bursts shall be applied in each mode. Insertion of blocking filters in the cables to the EUT may be necessary to prevent the burst energy being dissipated in the mains or in other interconnected units.

B-8.2 Peak Value Amplitude

The peak value amplitude used for the test shall be 0.5 kV.

NOTE — For full test details reference may be made to IEC publication 801-4 (1984) Electromagnetic compatibility for industrial-process measurement and control equipment, Part 4 : Electrical fast transient/burst requirements, as there is no Indian Standard available on the subject at present.

B-9 ELECTROSTATIC DISCHARGE

B-9.1 Test Procedure

A capacitor of 150 pF shall be charged by a suitable DC voltage source. The capacitor shall be then discharged through the EUT by connecting one terminal to ground (chassis) and the other via 150 ohms to surfaces which are normally accessible to the operator.

B-9.1.1 At least 10 discharges shall be applied. The time interval between successive discharges shall be at least ten seconds.

B-9.1.2 An EUT without a ground (earth) terminal shall be placed on a grounded plate which projects beyond the EUT by at least 0.1 m on all sides. The ground connection to the capacitor shall be as short as possible.

B-9.1.3 The discharge electrode shall approach the EUT until discharge occurs, and shall then be withdrawn before the next discharge.

B-9.2 Test Severity

The following severity shall apply:

Severity	1
DC voltage (kV) up to and including	8

NOTE — For full test details reference may be made to IEC Publication 801-2 (1984) Electromagnetic compatibility for industrial-process measurement and control equipment, Part 2 : Electrostatic discharge requirements, as there is no Indian Standard available on the subject at present.

B-10 ELECTROMAGNETIC SUSCEPTIBILITY

B-10.1 Test Procedure

The EUT shall be exposed to an electromagnetic field strength as specified by the severity level.

B-10.1.1 The field strength may be generated in various ways:

- the stripline is used at low frequencies (below 30 MHz or in some cases 150 MHz) for small EUT's;
- the long wire is used at low frequencies (below 30 MHz) for larger EUT's;
- dipole antennas or antennas with circular polarization placed 1 m from the EUT are used at high frequencies.

B-10.1.2 The specified field strength shall be established prior to the actual testing (without EUT in the field). At least 1 m of all external cables

shall be included in the exposure by stretching them horizontally out from the EUT.

B-10.1.3 The field shall be exposed in two orthogonal polarizations and frequency range shall be scanned slowly. If antennas with circular polarization (that is a log-spiral or a helical antenna) are used to generate the electromagnetic field, a change in the position of the antennas is not required. When the test is carried out in a shielded enclosure to comply with international laws prohibiting interference to radio communications, care needs to be taken to control reflections from the walls. Anechoic shielding may be necessary. At least 1 m of wiring to and from the EUT shall be exposed.

B-10.2 Test Severity

The following severities shall apply:

Severity	1a	1b
Frequency range (MHz)	0.1-500	500-1 000
Field strength (V/m)	10	3
Modulation	50% AM	1 kHz square wave

NOTE — For full test details reference may be made to IEC Publication 801-3 (1984) Electromagnetic compatibility for industrial-process measurement and control equipment, Part 3 : Radiated electromagnetic field requirements, as there is no Indian Standard available on the subject at present.

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